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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
Keeney, et al.	Examiner: L. Shapiro
Serial No.: 09/748,623	Art Unit: 2673
Filed: December 22, 2000	

For: **METHODS AND APPARATUS FOR REPAIRING INOPERATIVE PIXELS IN A DISPLAY**

Commissioner for Patents
Washington, DC 20231

I hereby certify that this correspondence is being deposited with the United State Postal Service as First Class Mail, postage prepaid, in an envelope addressed to the Commissioner for Patents, Washington, D.C. on November 15, 2002.

By: Carol Prentice
Carol Prentice

RESPONSE

Dear Sir:

This Response is responsive to the Office Action mailed on September 20, 2002.

Summary

The Examiner has objected to the specification based on an informality, namely that the meaning of "FLC-on-CMOS" on page 9, line 12 is not clear. FLC stands for "Ferro-electric Liquid Crystal" which is a particular variation of a liquid crystal display material and driving mode, as is commonly known in the art. Applicants respectfully request withdrawal of the objection to the specification.

Claims 1-28 stand rejected pursuant to 35 U.S.C. § 112, first paragraph, as containing subject matter not adequately described in the specification.

Claims 1-2, and 15-16 stand rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Henley (US 5,459,410) in view

of Kuwashiro (US 5,945,984).

Applicants respectfully traverse the foregoing rejections in view of the following comments.

Discussion of Examiner's Rejection under 35 U.S.C. § 112

The Examiner has rejected claims 1-28, indicating that the specification does indicate how the invention is applicable to AMLCD TFT panels of Digital Mirror Displays. The Examiner has therefore indicated that the specification and claims should be limited to LC micro-displays with CMOS drive circuitry.

Applicants respectfully submit that the present invention is not limited to LC micro-displays, which are merely provided as an example of a display with which the invention may be used (see, e.g., Applicants' specification, page 7, lines 29-30). It should be understood that Applicants' invention is directed towards repairing the drive circuitry of the pixels in a display, rather than repairing defects in the display optics.

In particular, the present invention is applicable to AMLCD TFT panel displays. TFT panel displays typically employ only one or two transistors per pixel. While it may not be efficient to add repair circuitry when the pixel circuit is only one or two transistors per pixel to start with, certain embodiments of the present invention can accomplish a repair with a minimal amount of additional circuitry. Such embodiments include those described as coupling the pixels together with a capacitive or resistive effect and disconnecting the defective drive by ablation or fusible link, or the like. These embodiments are suitable for use in TFT's and means to accomplish both the coupling and disconnect are described in the prior art, including Henley.

Similarly, the present invention is also applicable to Digital Mirror Displays (DMDs). The Gale patent (US 5,659,374) noted by the Examiner, discusses the repair of defects in a DMD

display by manipulating and/or destroying the mechanical state or function of the mirrors themselves. Gale discusses many types of defects that can be repaired. The defects can be lumped into two categories: defects in the mirrors; and defects in the CMOS drive circuitry. The present invention is concerned only with "logical" repair of the underlying drive circuitry, and not to repairs to the driven electro-physical-optical pixel mechanism of the display.

DMDs are specifically and particularly built on top of the exact same type of CMOS drive circuitry as used with LC on CMOS displays. The complexity and implementation per pixel is similar enough to be entirely and easily adaptable to incorporate most of the described embodiments of the present invention. Some embodiments of the present invention may not be entirely suitable to DMDs. For example, the DMD mirrors would most likely be in the way of the disconnection methods involving physical removal of the connection on the surface of the chip. Even in that case, the repair could still be accomplished during the intermediate manufacturing step between the creation of the standard CMOS drive circuit and the subsequent process of building the mirror structure on top of it.

What should be appreciated is that the essence of the invention - sharing a drive circuit to control both a working pixel and a pixel whose own drive circuitry is otherwise defective - is not a function of the display technology, but of the drive circuit technology. More particularly, the present invention is concerned with the logical connections between and among individual pixel drive circuits, the pixels, and data paths. Although the present invention was conceived and reduced to practice while working with CMOS drive circuits and LCOS displays, the specific technologies used to fabricate the optical portion of the display are not the central subject of the invention and do not limit the scope of the invention. The

present invention is concerned with, *inter alia*, the drive circuitry integrated into the substrate of the display. In the case of DMDs, the CMOS drive circuitry would be considered by one skilled in the art to be entirely equivalent to the drive circuitry in a LC-on-CMOS display.

Discussion of Henley

Henley discloses a method to repair inoperative pixels by providing redundant drive circuitry for each pixel (Col. 12, lines 13-41).

In contrast, the present invention is able to accomplish logical repair of the pixel drive circuitry while avoiding the overhead of a redundant drive circuit as used by Henley.

Redundant drive circuitry introduces several disadvantages that the present invention overcomes (as is explained in the background section of Applicants' specification). One large disadvantage is the complexity of routing the signals from the redundant circuitry to the defective pixel. The connection path between the redundant drive circuitry and all the possible pixels it can be used to repair has to be accommodated. Wires that span large numbers of pixels, columns, or rows tend to exhaust the available routing paths, perhaps requiring additional interconnects between metal layers, larger pixel pitch, and the like.

Alternatively described in the prior art, a trade-off to routing the signals from the redundant drive circuitry to large numbers of pixels is to have localized redundant drive circuits that serve a smaller number of pixels (in the extreme, one redundant circuit per pixel as described in Henley). Such a larger number of redundant drive circuits consumes area on the silicon chip that could be instead used for more complex drive circuits per pixel. Such redundancy will also increase the size

and cost of the device. In the extreme case of one redundant circuit per pixel as disclosed in Henley, the increase results in doubling the number of circuits.

In TFT LCDs the redundant circuitry can also impact fill factor and minimum pixel size since the transistors and interconnections are relatively large compared to the pixels in this technology and obscure some of the light-passing portion of the pixel area.

Additionally, when using redundant circuitry to effect pixel repairs, the input data to be displayed has to be routed to the correct redundant circuit, introducing even more complexity.

The examiner states: "One of ordinary skill in the art would select nearby pixel because of physical proximity the pixel and driver" (Office Action, page 4). As has been discussed, the referenced prior art is concerned with the perfect repair of the display using completely redundant drive circuitry. None of the prior art of record discloses or remotely suggests the concept of a repaired (defect-mitigated) display which is achieved by connecting multiple pixels to display the same value from the same drive circuit.

In the present invention, it has been discovered that for many applications of displays, the defect of having some pixels tied together here and there across the area of the display is not objectionable, and in practice is imperceptible, yielding a useful display even if every pixel is not "perfectly" repaired using redundant drive circuitry.

The present invention is clearly a distinct departure from Henley and other similar prior art. The present invention can be used to turn an otherwise unusable display and into a display that functions adequately for the application without necessarily being perfectly repaired and without the disadvantages of adding completely redundant drive circuits as required by Henley.

Henley does not disclose or remotely suggest repairing a

defective pixel by connecting an inoperative pixel to the working drive circuitry of a nearby pixel, as set forth in Applicants' claims.

Discussion of Kuwashiro

Kuwashiro teaches methods and apparatus for probing and detecting data signals at various points in the interconnection of a printed wiring board, a flexible circuit containing a driver IC, and an LCD display. Based on the result of the probing, one or more of these major components of the assembly are replaced to affect the repair.

Kuwashiro teaches the repair of a composite assembly by replacing the defective component (Col. 9, lines 42-44). In contrast, the present invention relates to the repair of those portions of the display circuitry that are monolithic and integral to the substrate of the display, for example a CMOS IC or a TFT LCD display. On these types of display substrates, it is not possible to re-assemble portions of the circuitry since the circuitry and display substrate are one monolithic component.

The teachings of Kuwashiro apply to the circuitry and connections external to the display substrate, but not the circuitry integral to the display.

In contrast, the present invention provides the ability to "logically" repair defective portions of the integral drive circuitry by switching the signal flow using logic gates or minor wiring changes. All of the circuitry utilized with the present invention is present when the monolithic substrate (IC or LCD glass with TFT's) is originally fabricated. In Kuwashiro, the repair is accomplished by detecting and replacing defective components of a composite display assembly in order to perfectly repair the display. In contrast, the logical repair provided by the present invention is accomplished by connecting an

inoperative pixel to share the circuitry of a working pixel without physically replacing any components. As discussed above in connection with Henley, the result with the present invention is not a perfectly repaired display, since nearby pixels will be tied together and display the same value.

Kuwashiro does not disclose or remotely suggest repairing a defective pixel by connecting an inoperative pixel to the working drive circuitry of a nearby pixel, as set forth in Applicants' claims.

Henley and Kuwashiro teach providing redundant circuitry and physically replacing components for pixel repair, respectively. The combination of Henley and Kuwashiro would not lead one of ordinary skill in the art to Applicants' invention. In particular, combining a reference which teaches the provision of redundant circuitry with a reference which teaches the replacement of defective circuitry would not lead one of ordinary skill in the art to repair a defective pixel by connecting the defective pixel to the working drive circuitry of a nearby pixel, as set forth in Applicants' claims. The combination of Henley and Kuwashiro would only provide one skilled in the art with <u>different ways in which to implement redundant or replacement repair circuitry</u> in a pixel display.

Applicants respectfully submit that the present invention would not have been obvious to one skilled in the art in view of the combination of Henley and Kuwashiro, or any of the other prior art of record.

Withdrawal of the rejections under 35 U.S.C. § 103(a) is therefore respectfully requested.

Further remarks regarding the asserted relationship between Applicants' claims and the prior art are not deemed necessary, in view of the above discussion. Applicants' silence as to any of the Examiner's comments is not indicative of an acquiescence to the stated grounds of rejection.

Conclusion

In view of the above, the Examiner is respectfully requested to reconsider this application, allow each of the presently pending claims, and to pass this application on to an early issue. If there are any remaining issues that need to be addressed in order to place this application into condition for allowance, the Examiner is requested to telephone Applicants' undersigned attorney.

Respectfully submitted,

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ATTORNEY DOCKET NO.: MGI-174
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Art Unit: 2673
Examiner: L. Shapiro

Sir:

Transmitted herewith is:

[X] A Response in the above-identified application (8 pages);

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The Commissioner is hereby authorized to charge any deficiency in the payment of the required fee(s) or credit any overpayment to Deposit Account No. 50-0625.

Very truly yours,

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